

WHAT IS CLAIMED:

[0035] 1. A system for processing a thumbnail image from a microscope slide to determine tissue locations on the slide, the system comprises:

a plurality of first components for identifying tissue regions and determining locations of tissue on the slide;

a motorized stage where a frame image containing the entire slide is taken with a camera; and

means for using information about the locations to generate control parameters for the motorized stage and the camera to ensure that a scanning process captures high quality images of only the tissue regions.

[0036] 2. The system of claim 1, wherein the plurality of first components include an image cropping component for identifying tissue regions on the slide to be scanned, wherein the image cropping component:

determines an approximate location of a slide boundary by searching upper and lower intervals corresponding to regions expected to contain upper and lower edges of the slide;

re-examines the approximate location to determine a more accurate location; and
removes portions of the image falling outside of the determined slide boundary.

[0037] 3. The system of claim 2, wherein the image cropping component converts a copy of the thumbnail image to a grayscale image.

[0038] 4. The system of claim 2, wherein the image cropping component crops a color thumbnail image at estimated edge locations, wherein multiple values of each pixel in the color thumbnail image are used to achieve better results by identifying spurious features on the slide.

[0038] 5. The system of claim 4, wherein the image cropping component crops the color thumbnail image at estimated boundary locations and uniformly reduces the color thumbnail image size to produce a small thumbnail image of the slide for rapid visual slide identification.

[0040] 6. The system of claim 3, wherein the image cropping component identifies pixel blocks that are likely to contain remaining boundary edges and flags these blocks as edges that should not be considered for high-resolution imaging.

[0041] 7. The system of claim 1, wherein the plurality of first components include a tissue finding component that locates regions in the thumbnail image that contain tissue of interest to a specialist.

[0042] 8. The system of claim 7, wherein a cropped grayscale image is inputted into the tissue finding component from a imaging cropping component, wherein the tissue finding component identifies tissue regions by applying a sequence of filters that incorporate knowledge of typical appearance and location of tissue and non-tissue slide regions and outputs a tiling matrix whose values indicate which tiles should be imaged.

[0043] 9. The system of claim 8, wherein a first filter analyzes mean and standard deviation of local pixel intensities and combines the mean and the standard deviation to generate a threshold value for making an initial classification of tissue versus non-tissue regions.

[0044] 10. The system of claim 9, wherein the intensities are used to differentiate tissue-containing regions from blank regions and other non-tissue containing regions.

[0045] 11. The system of claim 9, wherein the standard deviation represents the amount of variation in pixel values and is a good indicator of the border between tissue and the blank slide.

[0046] 12. The system of claim 8, wherein morphological filters are applied to threshold standard deviation data to refine classification based on size and position of neighboring groups of potential tissue pixels, wherein the morphological filters process

pixels of the cropped grayscale image in groups that correspond to slide regions that can be imaged individually during a high-resolution scanning process.

[0047] 13. The system of claim 12, wherein the morphological filters ensure that tiles that partially filled with tissue are classified as tissue-containing tiles.

[0048] 14. The system of claim 8, wherein other image characteristics can be used to identify tissue from non-items of interest.

[0049] 15. The system of claim 1, wherein the frame image is a single macroscopic image.

[0050] 16. The system of claim 1, wherein the frame image is multiple macroscopic images.

[0051] 17. The system of claim 1, wherein the plurality of first components includes a scan control component that interprets a tile matrix, outputted by a find tissue component, and transposes positions of the tile matrix into actual stage coordinates for a microscopic imaging.

[0052] 18. A method for processing a thumbnail image from a microscope slide to determine tissue locations on the slide, the method comprises the steps of:

flat-field correcting the thumbnail image using a blank slide and a similar image obtained from a camera that captured the thumbnail image;

cropping the thumbnail image by an image cropping component;

inputting a cropped grayscale image into a tissue finding component, wherein the tissue finding component identifies tissue regions by applying a sequence of filters that incorporate knowledge of typical appearance and location of tissue and non-tissue slide regions and outputs a tiling matrix whose values indicate which tiles should be imaged; and

interpreting the tiling matrix, by a scan control component, and transposing positions of the tiling matrix into actual stage coordinate for a microscopic imaging.

[0053] 19. The method of claim 18, wherein the step of cropping further comprises the steps of:

determining an approximate location of a slide boundary by searching upper and lower intervals corresponding to regions expected to contain upper and lower edges of the slide;

re-examining the approximate location to determine a more accurate location; and

removing portions of the image falling outside of the determined slide boundary.

[0054] 20. The method of claim 19, further comprising the step of converting a copy of the thumbnail image to a grayscale image.

[0055] 21. The method of claim 19, further comprising the step of cropping a color thumbnail image at estimated edge locations, wherein multiple values of each pixel in the color thumbnail image are used to achieve better results by identifying spurious features on the slide.

[0056] 22. The method of claim 19, further comprising the step of cropping the color thumbnail image at estimated boundary locations and uniformly reducing the color thumbnail image size to produce a small thumbnail image of the slide for rapid visual slide identification.

[0057] 23. The method of claim 20, further comprising the steps of identifying pixel blocks that are likely to contain remaining boundary edges and flagging these blocks as edges that should not be considered for high resolution imaging.

[0058] 24. The method of claim 18, further comprising the steps of analyzing mean and standard deviation of local pixel intensities and combining the mean and the standard deviation to generate a threshold value.

[0059] 25. The method of claim 24, further comprising the step of using the intensities to differentiate tissue-containing regions from blank regions and other non-tissue containing regions.

[0060] 26. The method of claim 18, further comprising the step of applying morphological filters to threshold standard deviation data to refine classification based on size and position of neighboring groups of potential tissue pixels, whereby the morphological filters process pixels of the cropped grayscale image in groups that correspond to slide regions that can be imaged individually during a high-resolution scanning process.

[0061] 27. A system for processing a thumbnail image from a microscope slide to determine tissue locations on the slide, the system comprises:

an image cropping component for cropping the thumbnail image;

a tissue finding component that identifies tissue regions by applying a sequence of filters that incorporate knowledge of typical appearance and location of tissue and non-tissue slide regions and outputs a tiling matrix whose values indicate which tiles should be imaged;

a scan control component for interpreting the tiling matrix; and

means for inputting a cropped image from the image cropping component into the tissue finding component and for transposing positions of the tiling matrix into actual stage coordinate, by the scan control component, for a microscopic imaging.